Space Weather Technical Forecast

Issued on Sunday, 24 October 2021 at 01:15 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Daily Slight Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low through the UTC day of Saturday 23 October, with X-ray activity measured at GOES 16 comfortably confined to within B-class. There were two numbered sunspots on the disc in the period: the first, AR2886 a simple unipolar Hsx/Alpha group near the solar meridian, with this spot stable and inactive. The second, AR2887 was larger and more complex, almost taking the guise of a pair of co-rotating regions, but for being combined in HMIBC imagery and with their plages interconnected. This group was assessed as a Dai/Beta, with minor proliferation evident in its southern spots, leading to overall areal growth. This latter group was responsible for much of the X-ray flare activity in the period, although there appears to be a bright flux region making some contribution, poised on the southeastern limb. Up to two very minor unnumbered groups in the northeast faded in the period.

While there are numerous small filaments on the solar disc at present, these appear stable at the time of writing. All observed Coronal Mass Ejections (CMEs) in available satellite imagery were peripheral - mostly from behind the eastern limb - with none thought to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: The solar wind showed a descent into a slow regime in the period, with the solar wind speed measured by DSCOVR at L1 falling from a slightly elevated 475km/s peak to decline in earnest later in the UTC morning to reach 350km/s by the period's end. The solar wind density followed a flat trend within long-term background in mid-single figures ppcc, while the IMF was unremarkable and stable at or below 5nT throughout. The north-south component of the IMF therefore had little scope for variation, reaching limits of +/-3nT, while the phi angle changed from predominantly negative (towards the sun) to become more neutrally-orientated late in the period.

The net result of the preceding solar wind measures was provisionally Quiet Kp throughout, peaking at just 2- in the 00-03UTC and 09-12UTC intervals.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured by GOES-16 was at Background levels, with no solar radiation storms observed.

High energy electron flux (greater than 2MeV) was predominantly at background levels. Associated 24-hour electron fluence was well below the Active (1e8 integrated pfu) threshold, with 1.69e6 integrated pfu recorded at 24/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a daily Slight Chance of M-class flares, largely the result of the complexity of AR2887, although this has yet to be borne out in observed X-ray activity. There are possible returning regions now lying on the southeast limb and perhaps just over the

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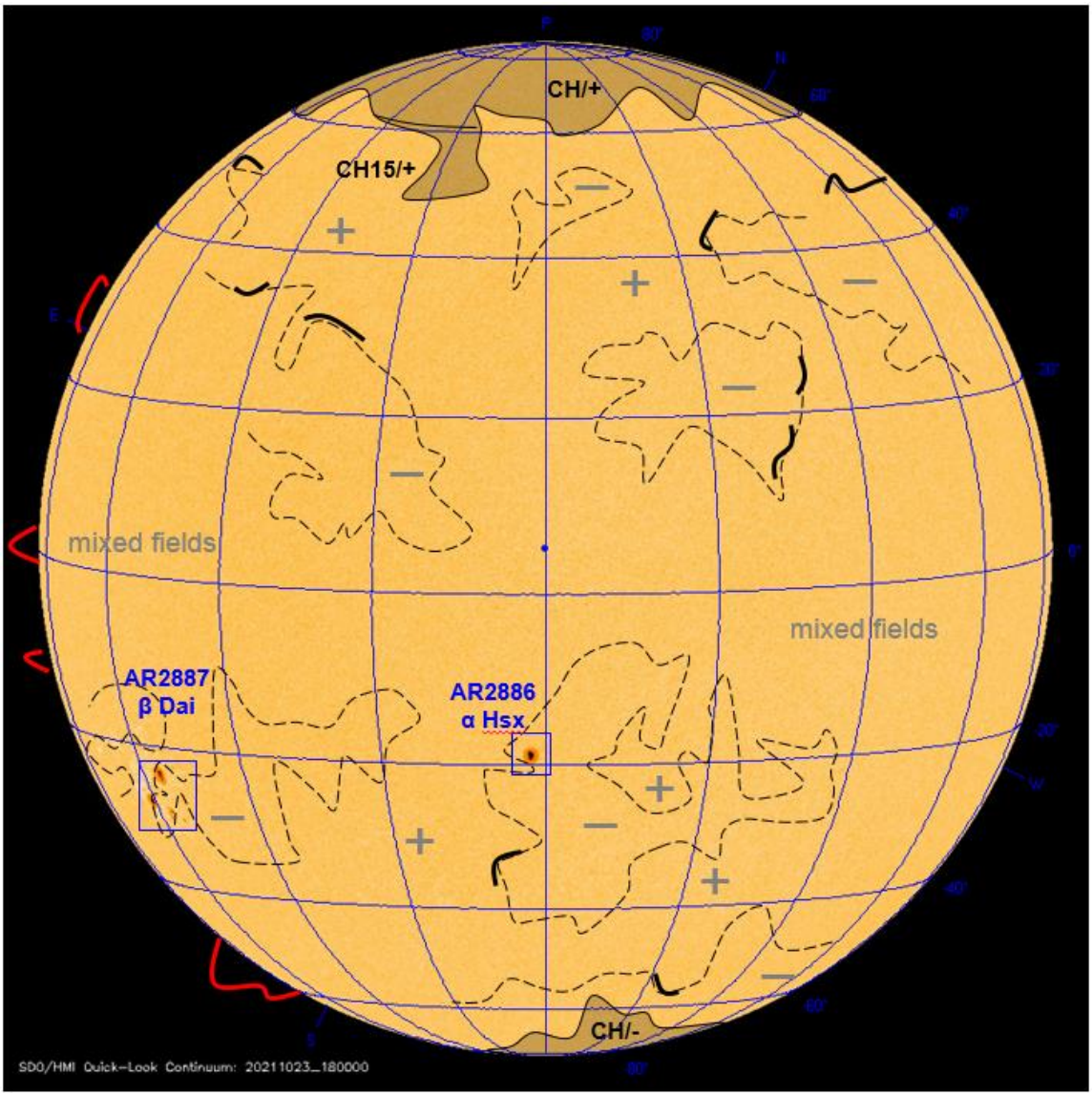
northeast that may yet increase probabilities into the new working week (UTC), however these do not yet feature in the percentages.

Solar Wind / Geomagnetic Activity: No CMEs feature in this forecast period, and no coronal hole high speed streams are expected to arrive. A Quiet geomagnetic forecast is expected to be the result.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, with no solar radiation storms currently expected. The high energy electron flux (greater than 2MeV) is likely to remain at Normal Background levels, with the 24-hour fluence expected to remain well below Active.

Figure 1. Solar Analysis Valid 23/1800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth underwent a gradual exit from the high speed stream from coronal hole 13 in the last 24 hours, with this expected to have been the only coronal hole in the four-day period. No CMEs currently feature either, and the geomagnetic forecast is expected to be Quiet throughout as a result.

STEREO A PLASTIC measurements show a slow solar wind environment for the next three days (near 350km/s), while the coronal hole responsible for activity on last rotation extending from the northern crown only exists as a vestigial eastward-shifted remnant (CH15/+), with this both unlikely to be significant, and unlikely to arrive within the next four days.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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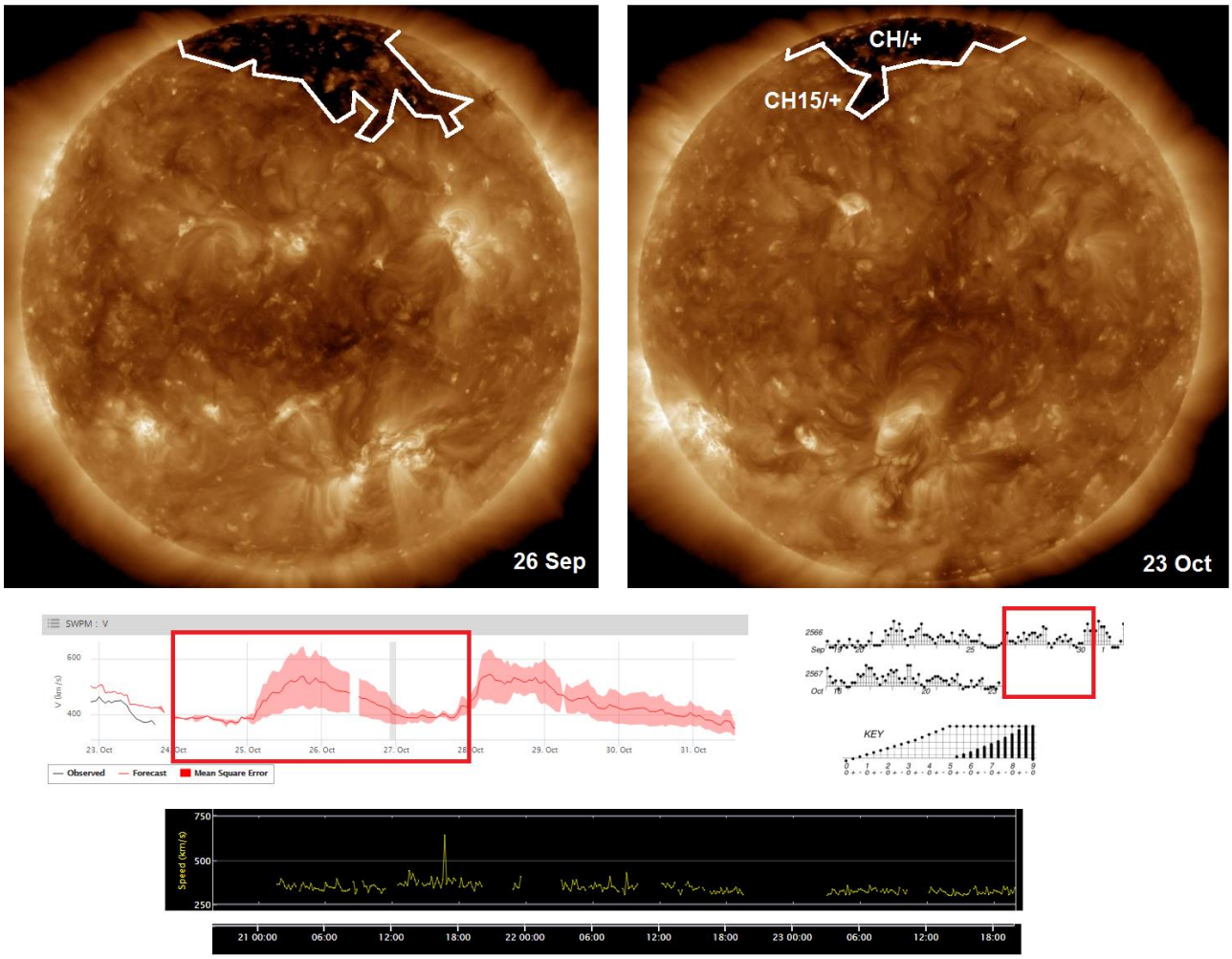
Figure 2: Top: AIA 193 imagery showing large differences in northern crown coronal hole and extensions, implying (middle) SWPM solar wind speed and geomagnetic activity may not be realised on this rotation, as suggested by (bottom) STEREO A solar wind speed for past three days.



Radio Blackouts - X-Ray Flares:

The X-ray forecast is the only aspect of space weather expected to depart from background conditions in the period, with a daily Slight Chance of M-class flares.

This is largely the result of sunspot region AR2887 in the southeast quadrant, which currently is assessed as having Dai/Beta complexity and has shown a recent growth trend. Perhaps because of its age, the raw X-ray probabilities appear to be over-estimates (for lack of even C-class activity this far during its occupancy of the Earth-facing disc), and probabilities have therefore been revised downwards to a daily 40% Chance of C-class and 10% of M.

The prospects for significant X-ray activity may increase in the four days however - there is currently a bright flux region lying on the southeastern limb that is not yet analysable, which appears to be making a minor contribution to current front-side activity. Added to this, the Carrington location for returning region AR2883 lies a couple of days behind the northeastern limb, and may well bolster the risk of flares should it have survived the far-side crossing, and indeed EUVI195 imagery on STEREO A suggests that it has.

The potential spots do not yet feature in the current forecast, with the risk of significant flares therefore held at a daily 10% Slight Chance for M-class due to AR2887 alone.

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X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Current HMIIF and HMIBC imagery of AR2887, with the HMIIF imagery perhaps reminiscent of an upper and lower group of sunspots co-rotating, although they appear well-connected by plage and magnetically.

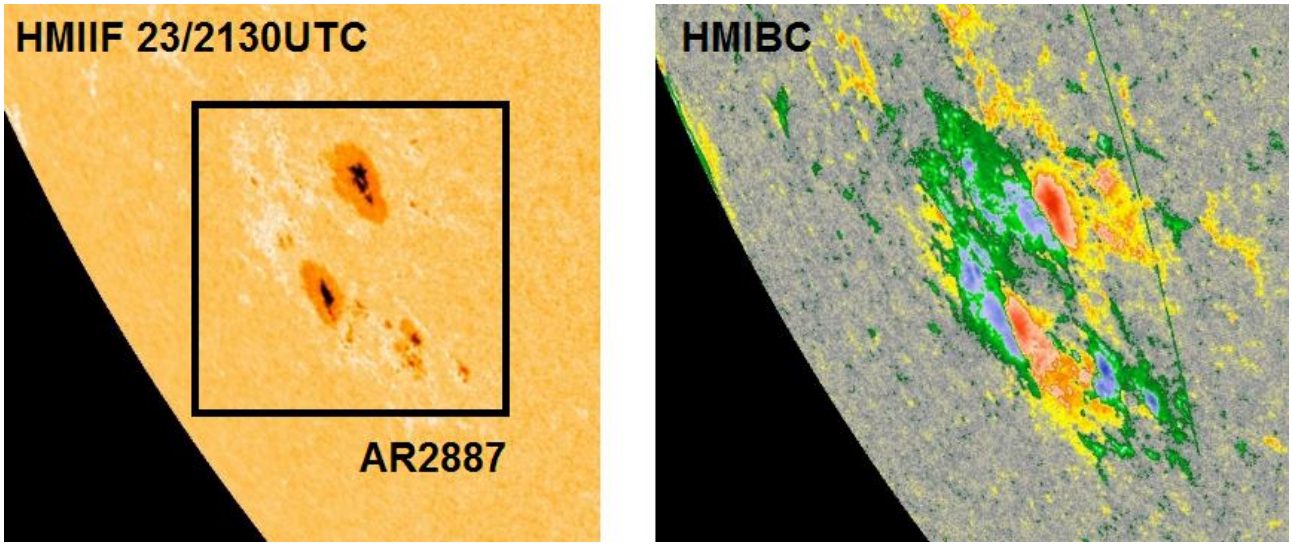
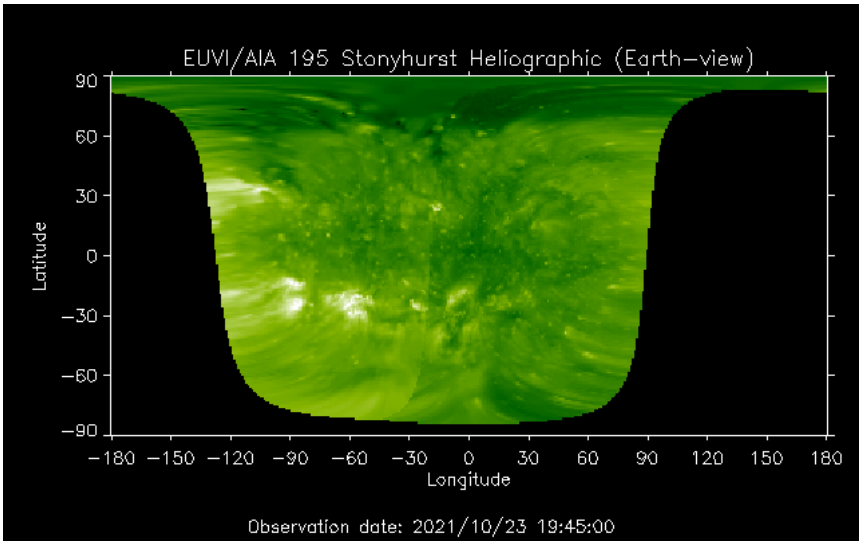


Figure 4: Whole sun in EUV, showing southeast limb bright flux region and a possible northern hemisphere rear-sided region that perhaps corresponds to ex-2883.



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Solar Radiation Storms - (High Energy Protons):

With no significant sunspots in geoeffective positions on the Sun, solar radiation storms are currently not expected.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is currently at Normal Background levels, having failed to respond to the recent exit from coronal hole 13's high speed stream. With no further enhancements expected in the four-day forecast period, should it not experience an uncharacteristically exaggerated reaction to the recent fast wind, it is unlikely to react for the remainder of the period, and Normal Background flux and sub-Active fluence should persist throughout.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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